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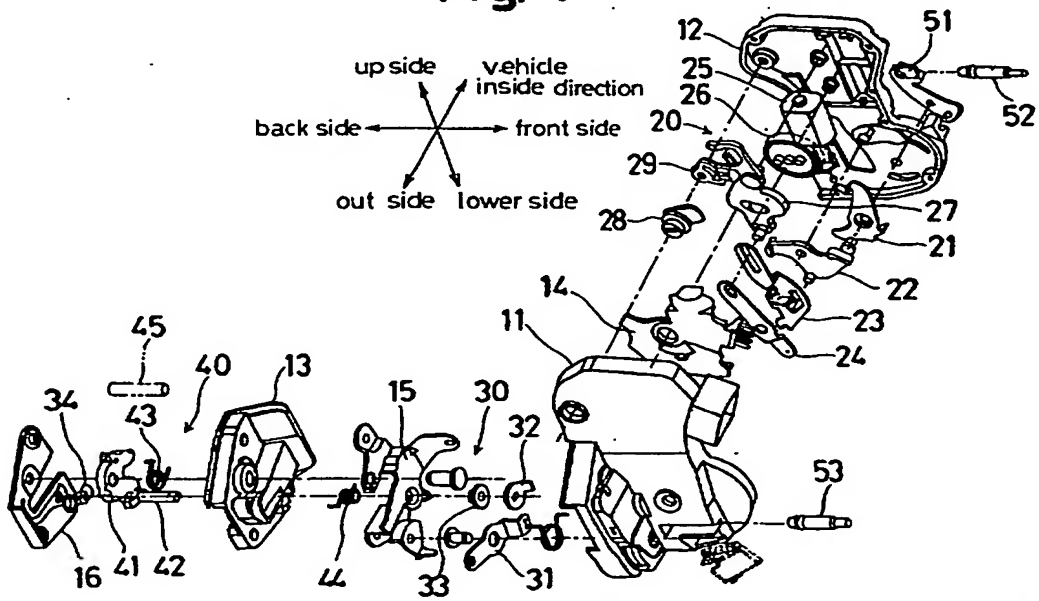
(54) Abstract Title
Door lock system for vehicle

(57) A door lock system for a vehicle comprises a latch mechanism (41, 42) securable to a vehicle door for latching the vehicle door to a vehicle body, and a latch release mechanism. The latch release mechanism comprises a floating link (23) movable between an unlocked condition in which it is engageable with the latch mechanism (41, 42) for release thereof and a locking condition in which it cannot engage the latch mechanism (41, 42), a swing lever (27) connected to the floating link (23), an electric driving source (25) having a gear member (25a), and a rotary gear member (26) arranged between the swing lever (27) and the electric driving source (25) in mesh with the gear member (25a) of the electric driving source (25), the rotary gear member (26) being directly and engageably connected to the swing lever (27).

Fig. 1



At least one drawing originally filed was informal and the print reproduced here is taken from a later filed formal copy.

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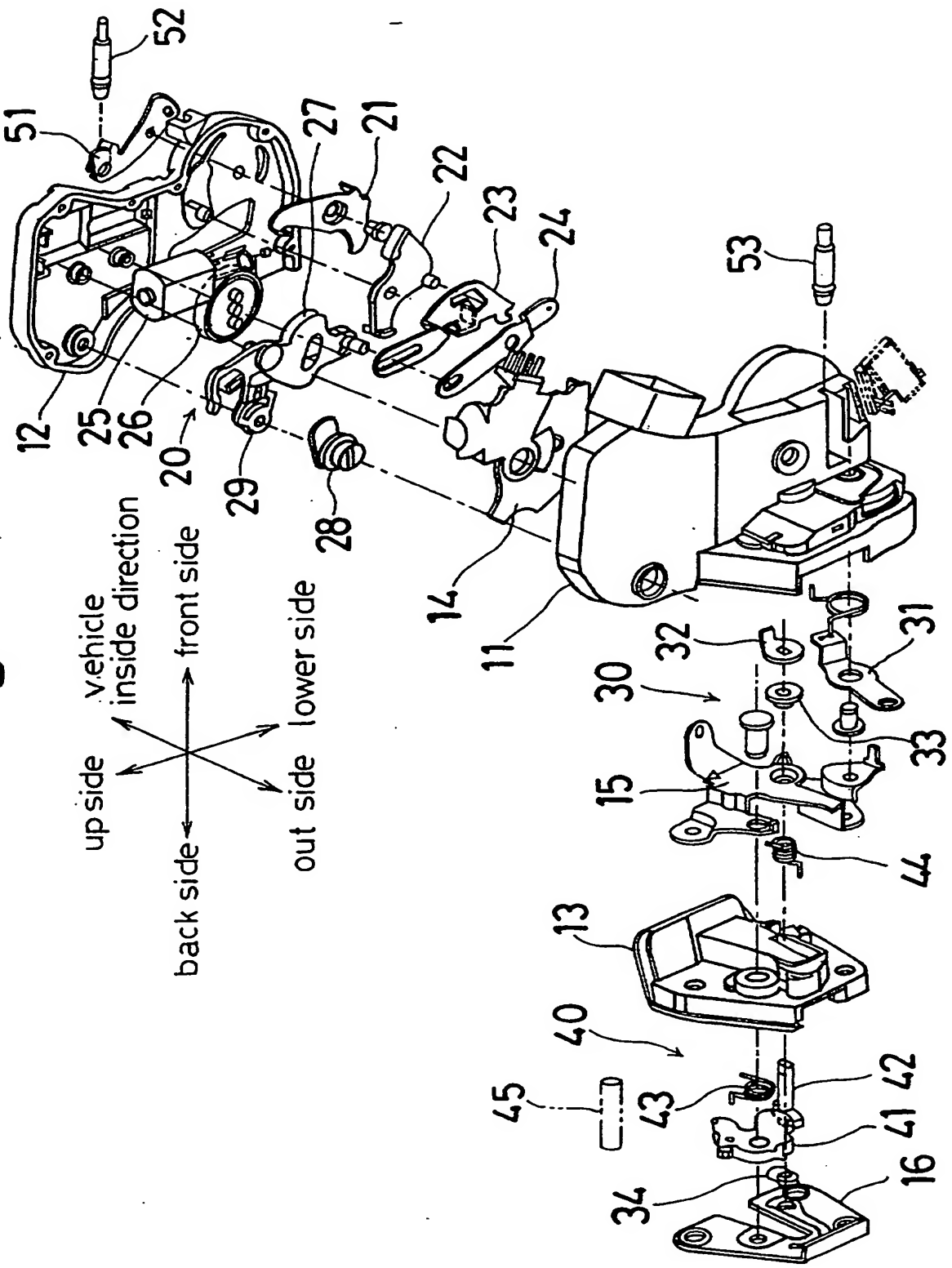
Fig. 1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20
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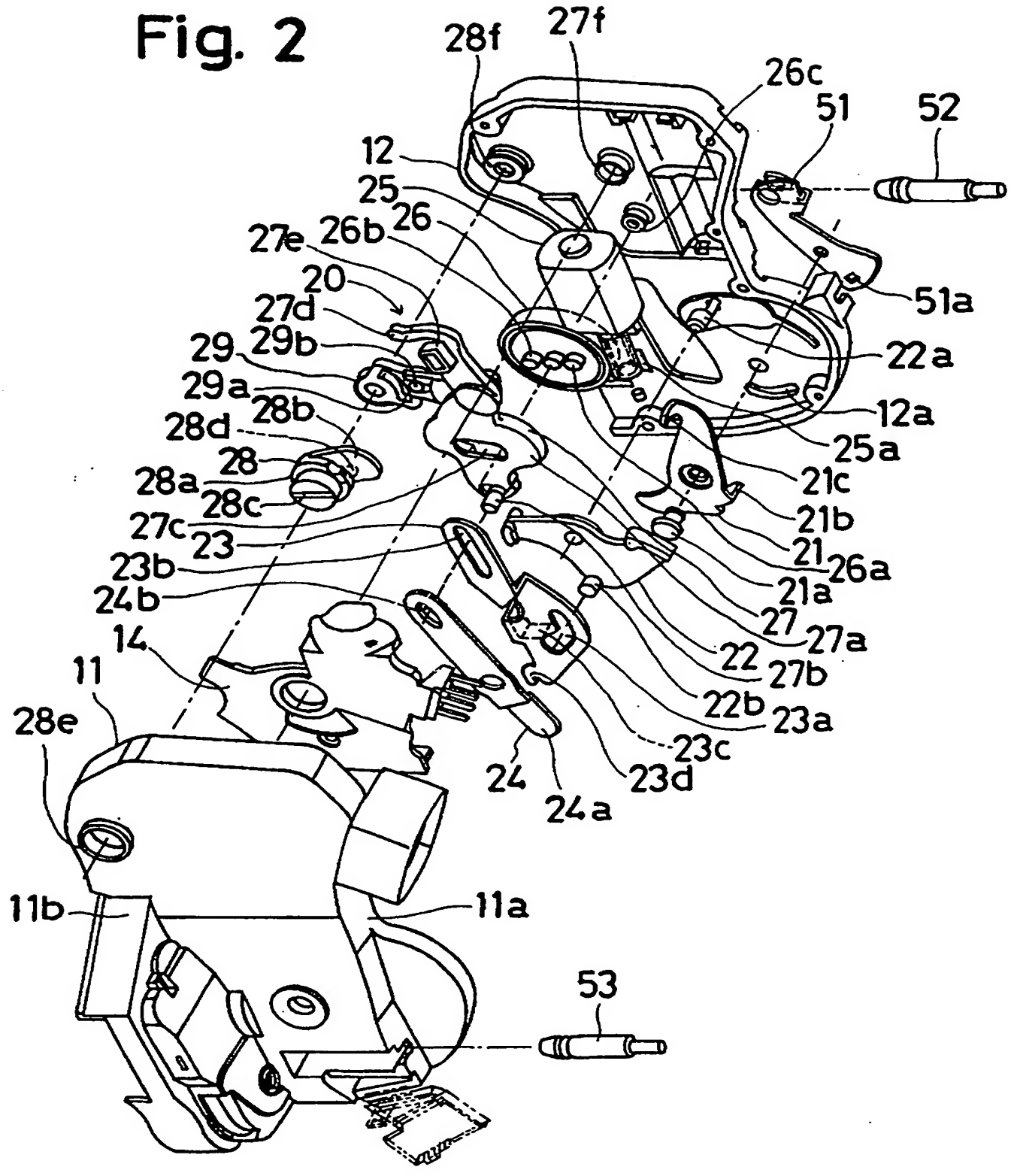
33
15
44
13
40
45
43
42
41
16
34
vehicle inside direction
front side
up side
out side
lower side
back side

Fig. 2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11a
53
24
24a
23d
23c
23a
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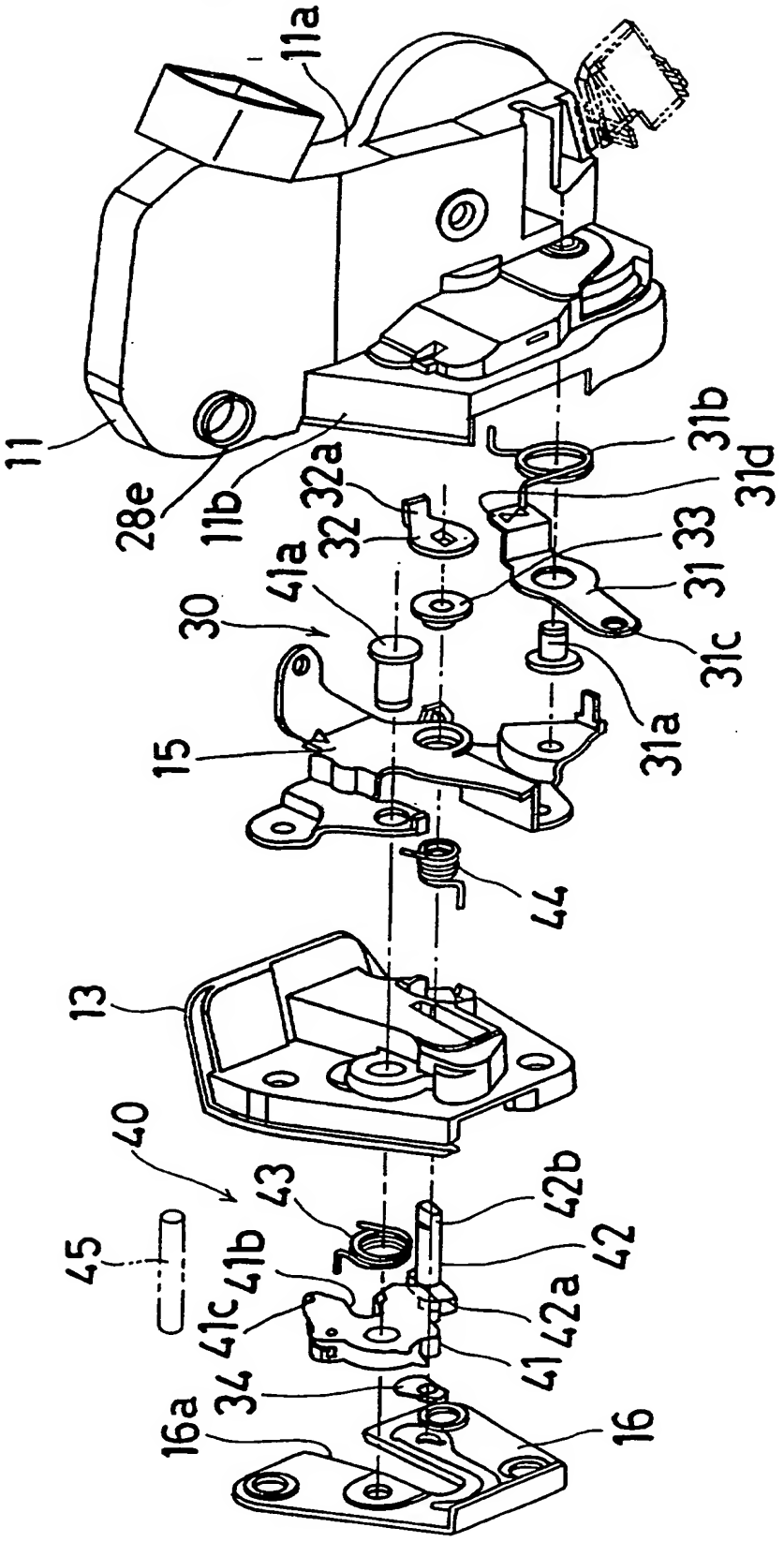
12a
22a
51a

Fig. 3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16a
16

Fig. 4

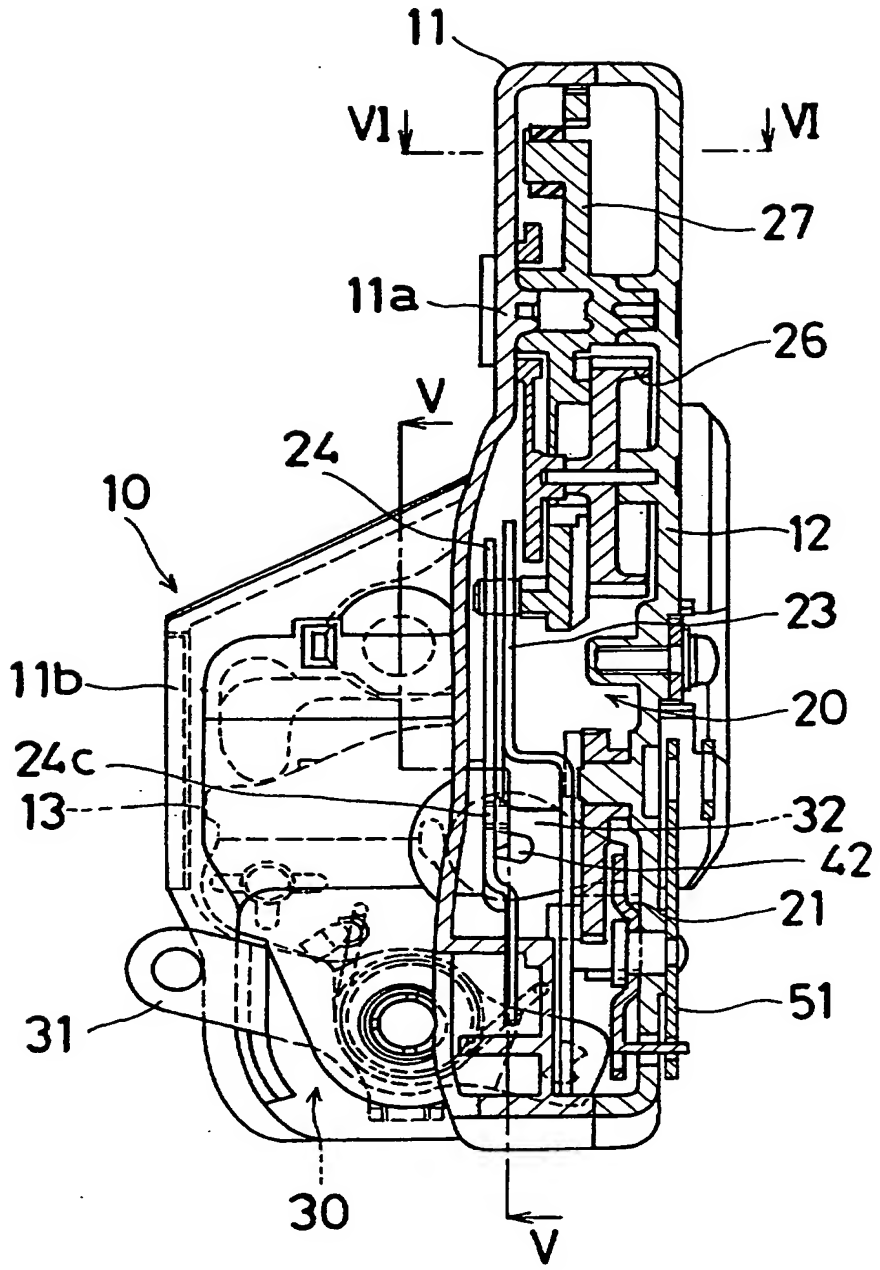


Fig. 5

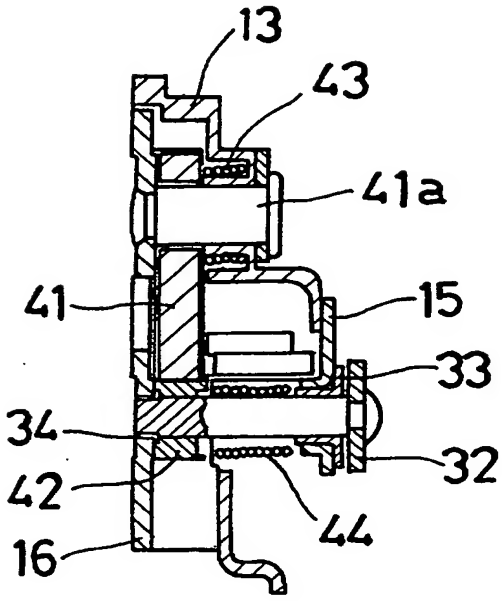


Fig. 6

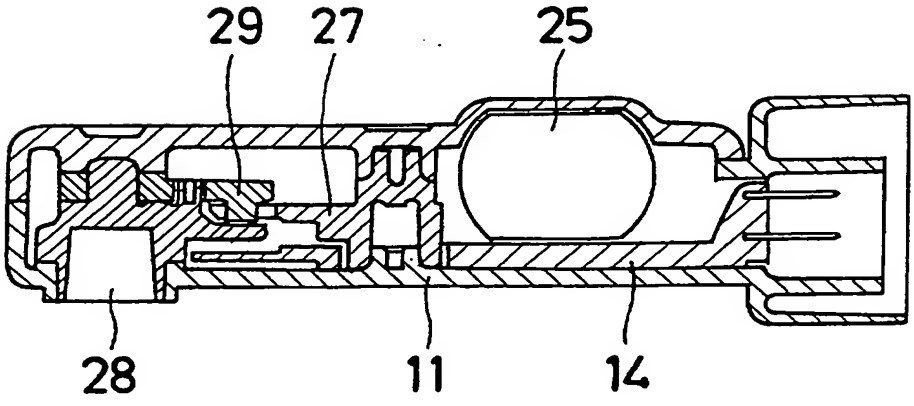
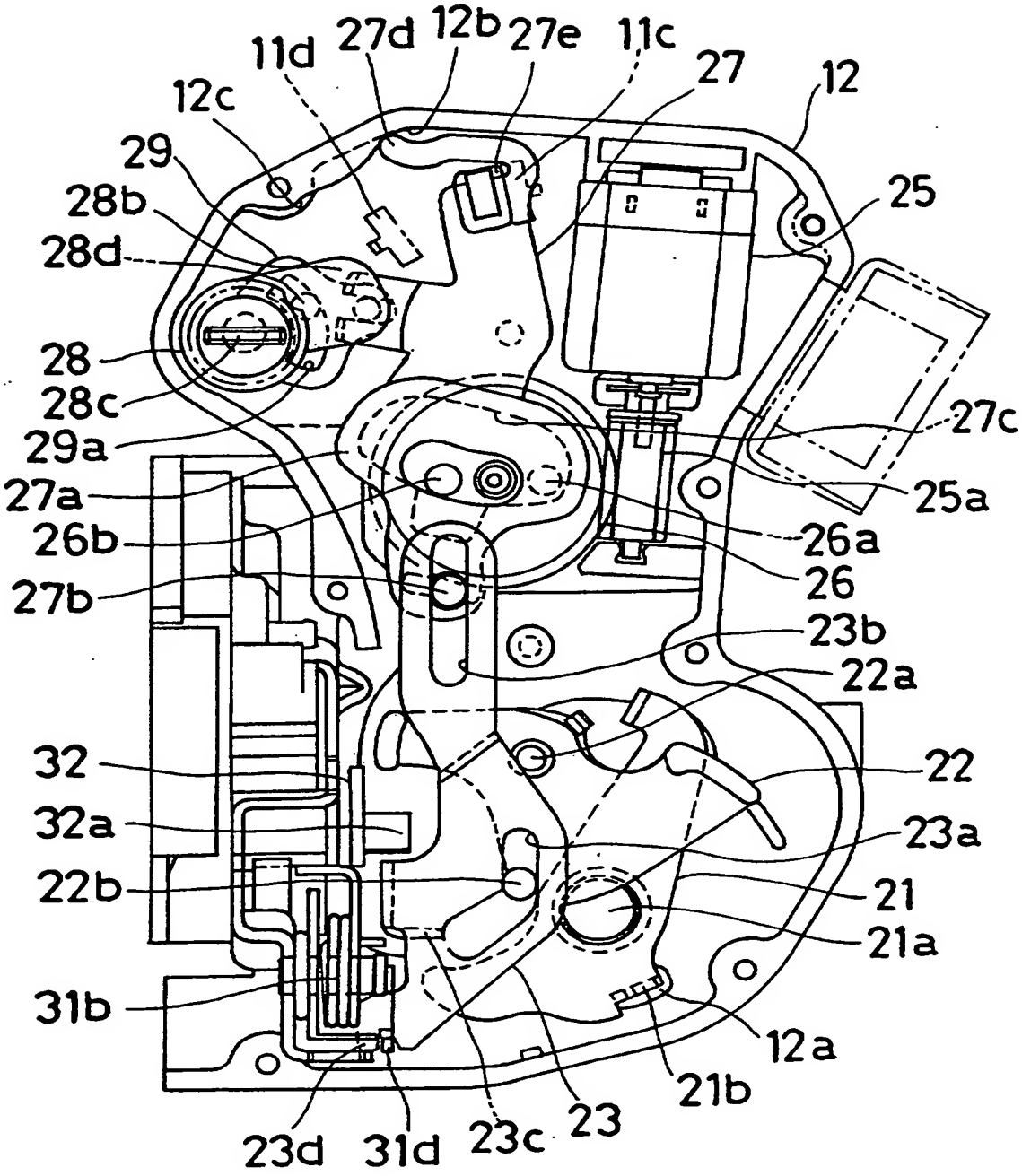


Fig. 7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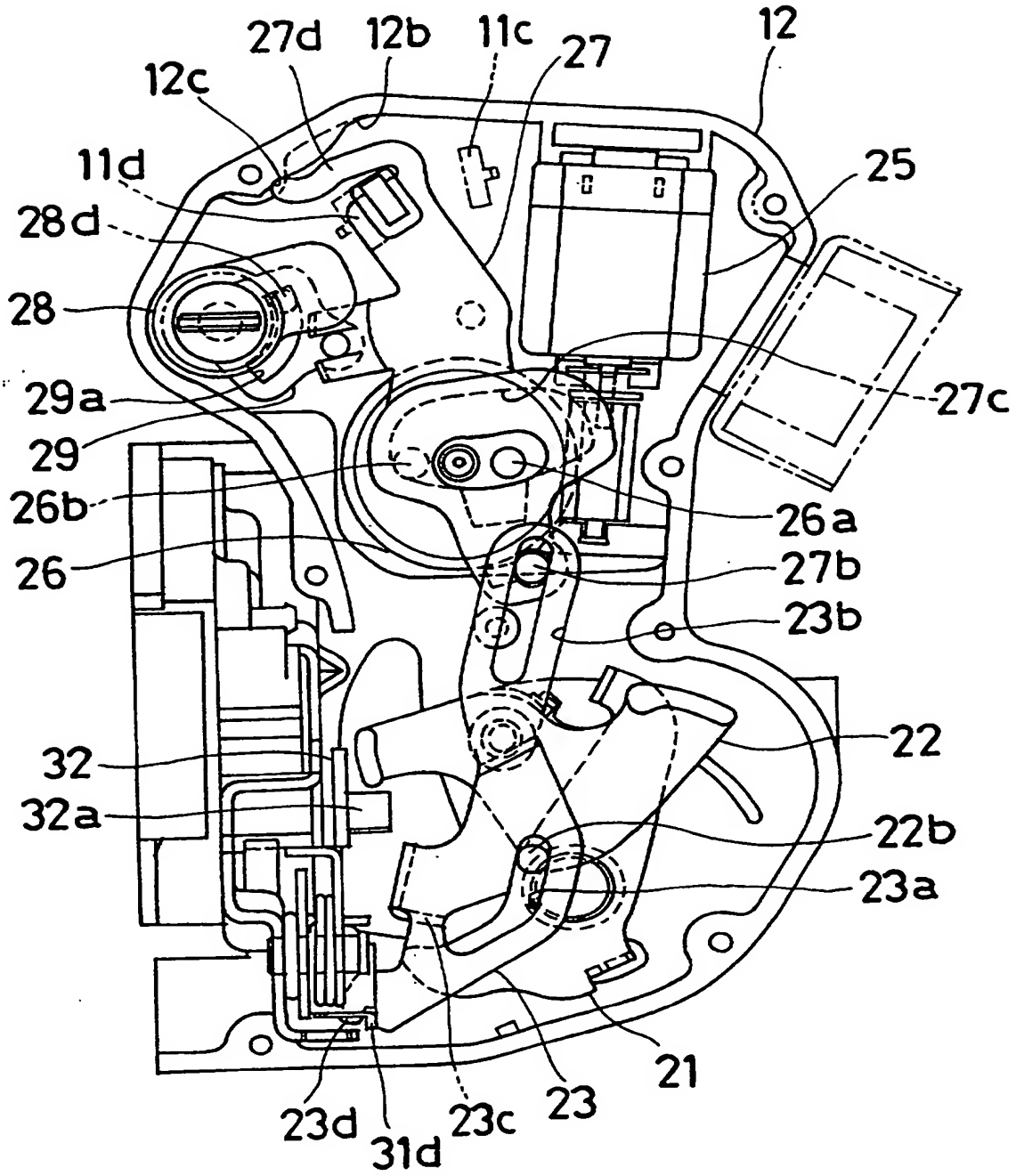
23c
23

Fig. 8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32a
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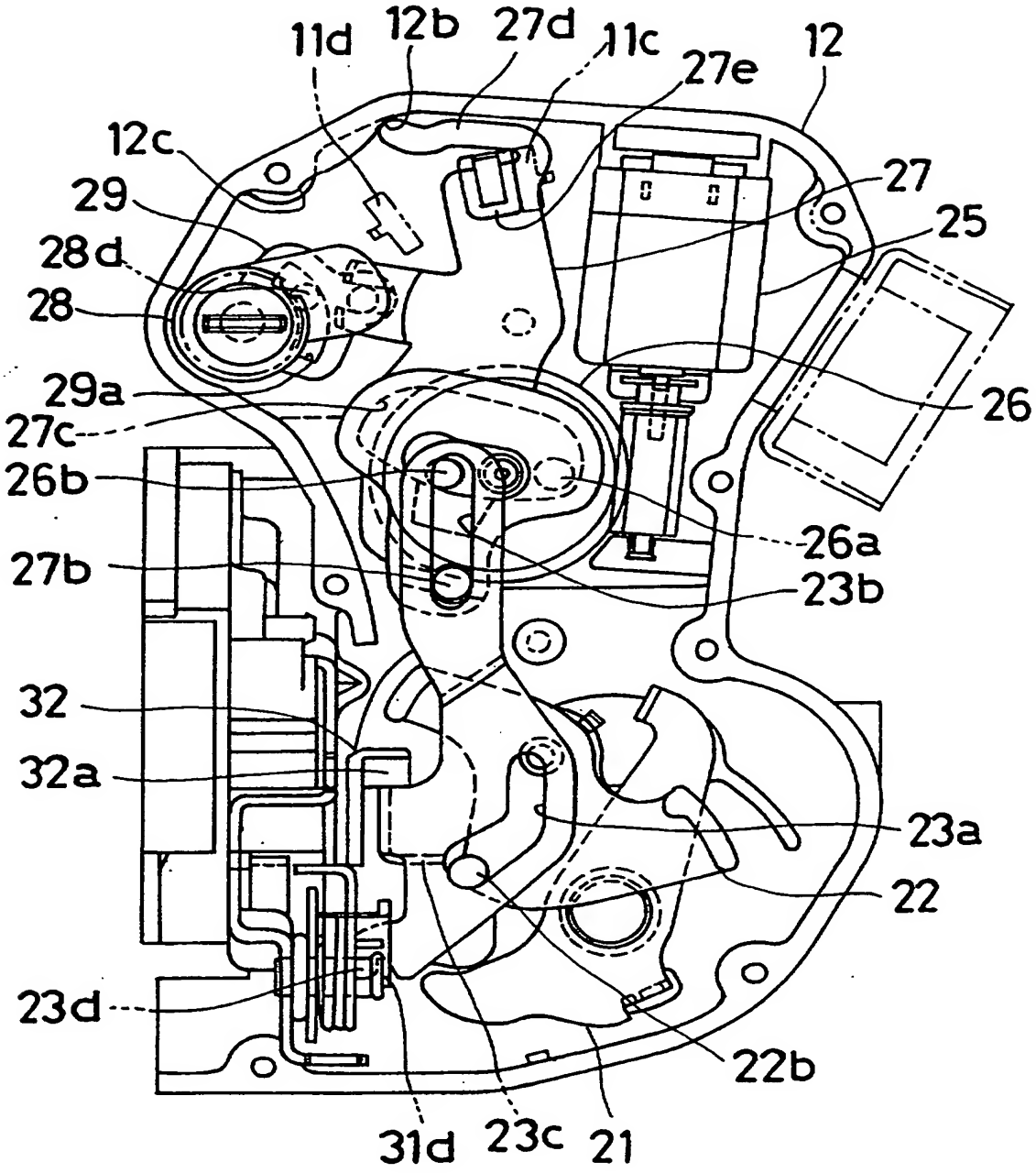
23d
31d
23c
23

Fig. 9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31d
23c
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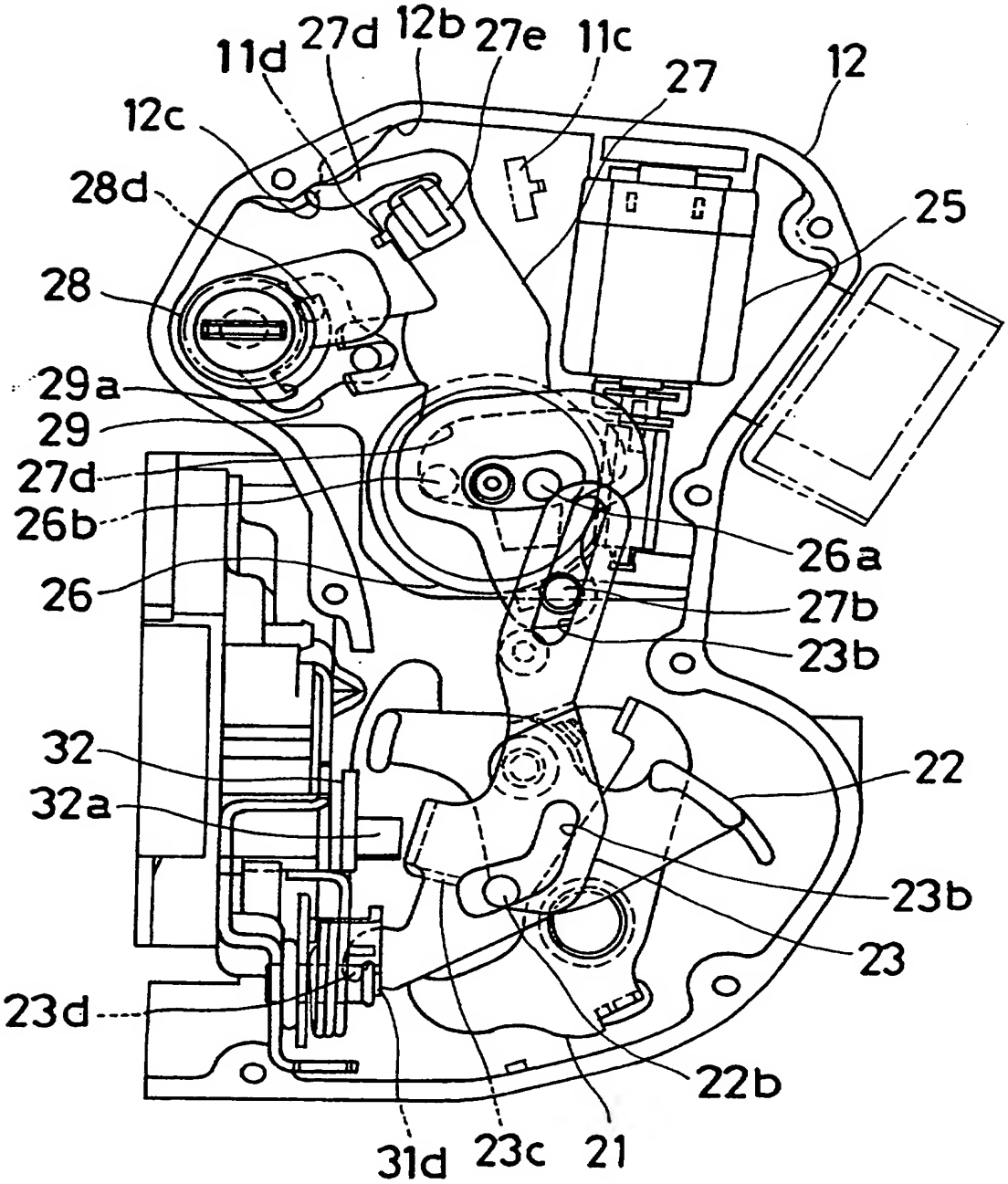
Fig. 10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23c
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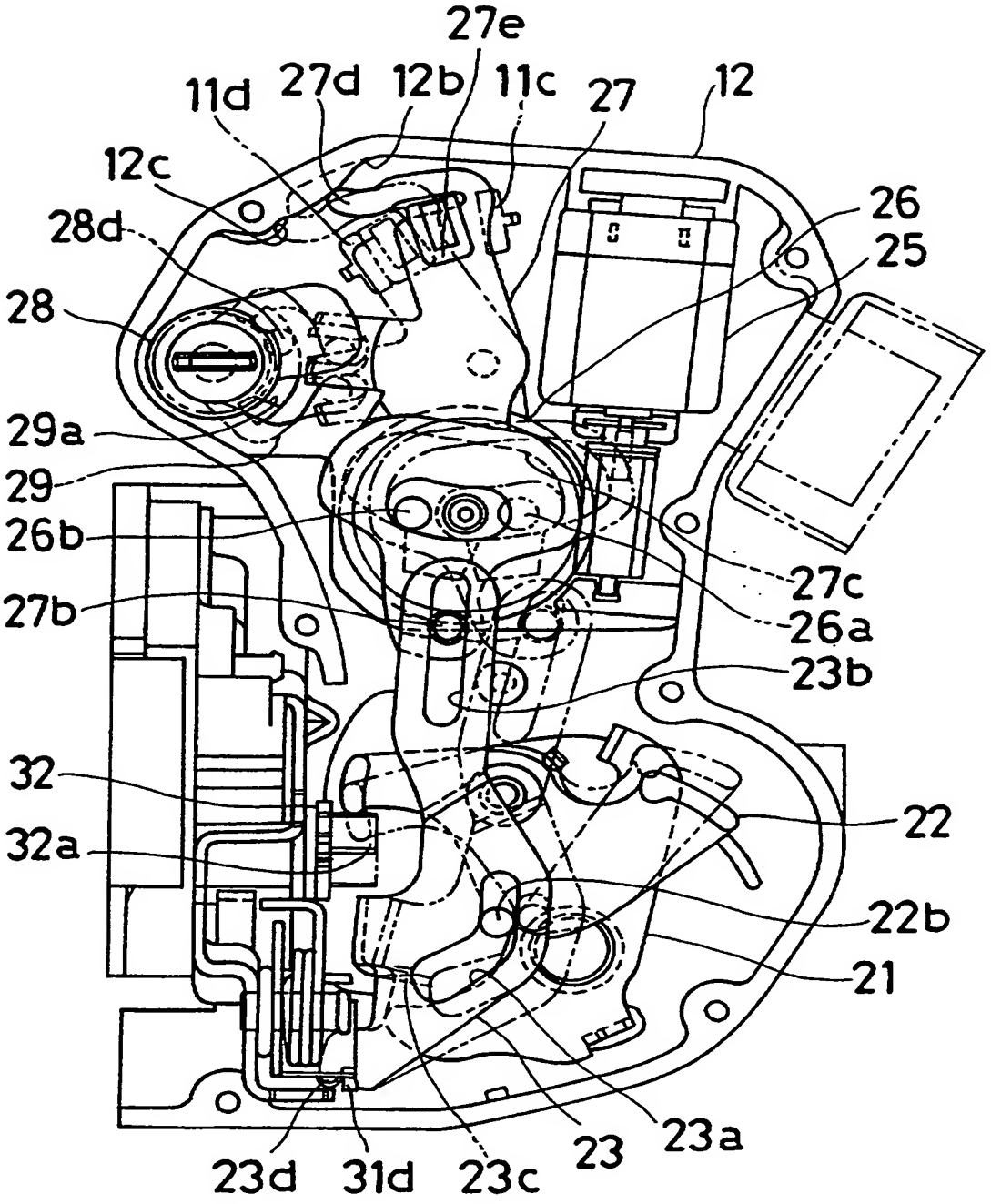
Fig. 11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22b
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23d
31d
23c
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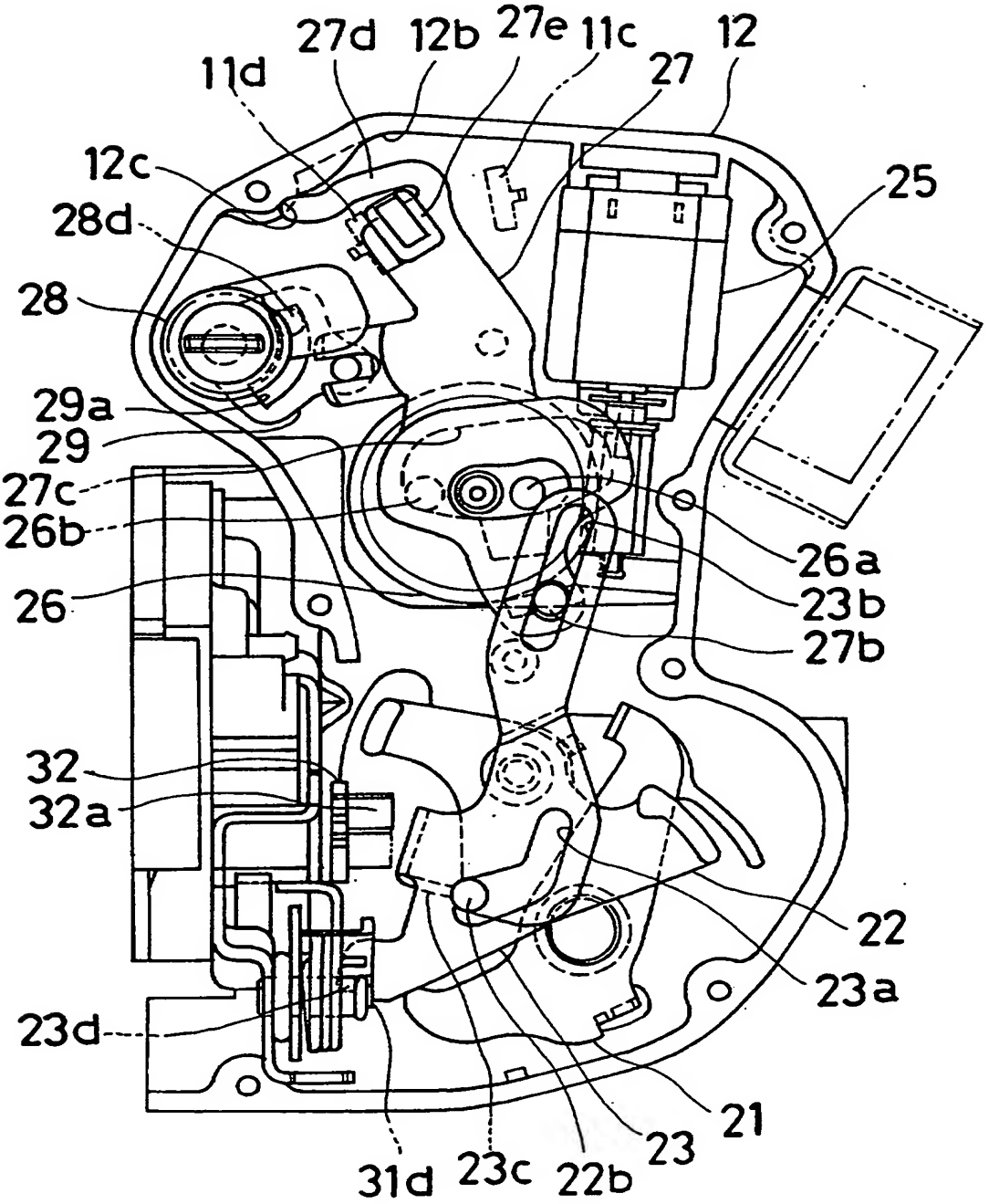
23a

Fig. 12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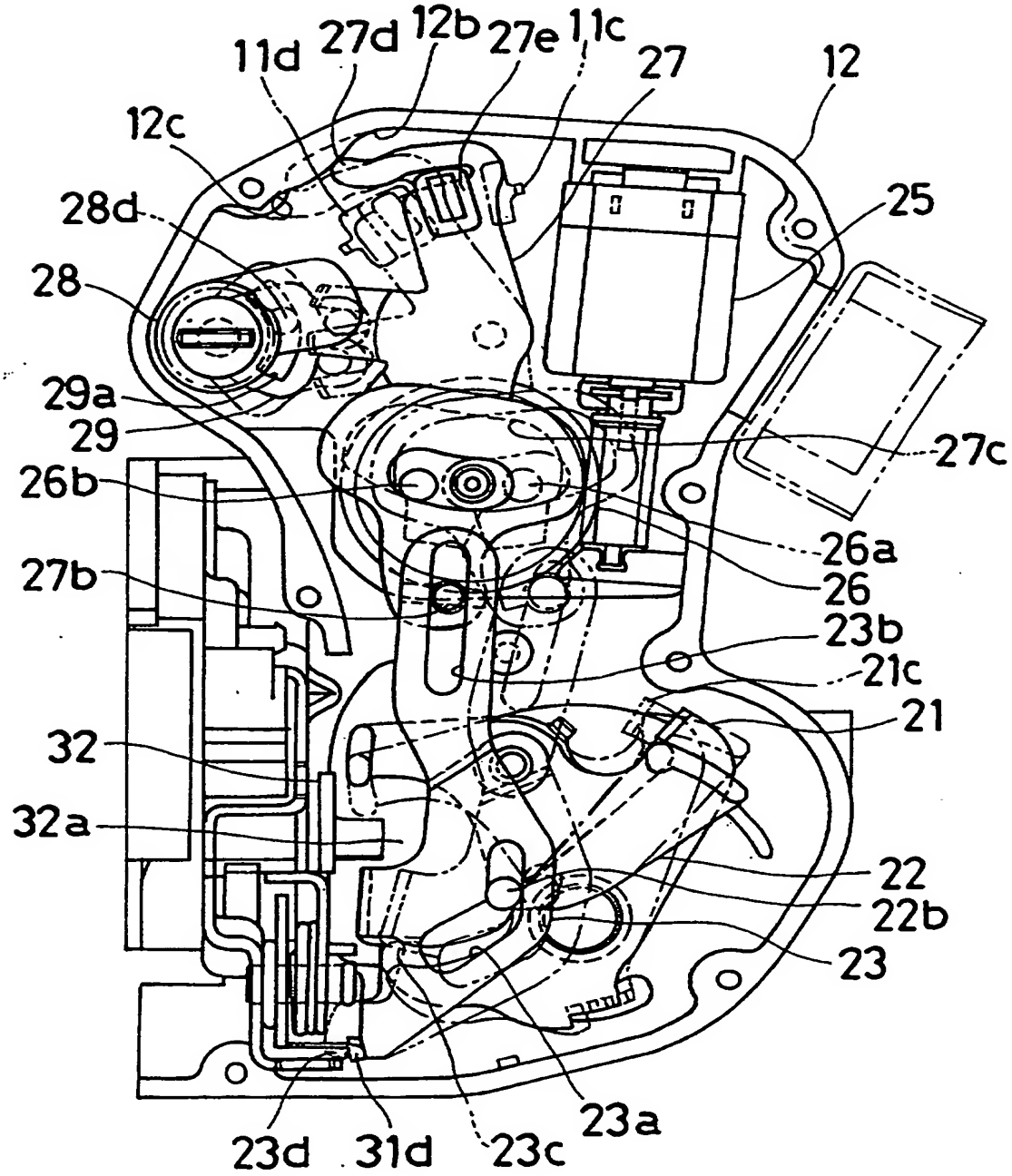
31d
23c
22b

Fig. 13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23b
21c
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23d
31d
23c
23a

TITLE

Door Lock System For Vehicle

DESCRIPTION

BACKGROUND OF THE INVENTION

Field of the invention

This invention relates to a door lock system for a vehicle.

Description of related arts

A type of door lock system for a vehicle is proposed in Japanese Patent Publication H7-103735 published on November 8, 1995. The door lock system for the vehicle comprises a latch mechanism including a latch and a latch release mechanism provided in a vehicle door. The latch engages a striker secured to a vehicle body. A link mechanism is provided, including a plurality of lever members and an electric actuator member for selectively enabling the latch release mechanism (the so-called 'door unlocked condition') or disabling the latch release mechanism (the so-called 'door locked condition').

In the above door lock system for the vehicle, all structural members of the link mechanism of the door lock system are supported by a base plate disposed in the door. Some of the structural members of the link mechanism are accommodated on the inside of the base plate relative to the vehicle, but the others are exposed on an outside of the base plate. Thus the members exposed to the outside of the base plate may be capable of being operated from the outside of the vehicle through a gap between the door and the body of the vehicle. Therefore the door lock may be unlocked and opened. In addition, the structural members of the link mechanism exposed on the outside of the base plate may be exposed to any water entering the door.

To overcome the above problems, it has been proposed to provide a protector on the base plate for accommodating within the protector the structural members exposed on the outside of the base plate. But, the above protector has to be added from outside as an additional member of the link mechanism, whereby the manufacturing cost, in

man-hours of assembly time and in the number of components, is increased. Furthermore the door lock system as a whole can become oversized. Accordingly, in the door lock system, it would be preferable to accommodate all of the structural members within a single closed housing.

In this case, it becomes a problem as to how the structural members exposed on the outside of the base plate can be accommodated in a compact closed housing. The main member exposed on the outside of the base plate is the electric actuator member, which is large in size compared to the other structural members. Therefore it is a serious problem as to how to structure in a compact manner within the closed housing the connecting portion between an output portion of the electric actuator member and a locking/unlocking operating means.

SUMMARY OF THE INVENTION

The invention provides a door lock system for a vehicle, comprising a latch mechanism securable to a vehicle door for latching the vehicle door to a vehicle body, and a latch release mechanism comprising:

a floating link movable between an unlocked condition in which it is engageable with the latch mechanism for release thereof and a locking condition in which it cannot engage the latch mechanism;

a swing lever connected to the floating link;

an electric driving source having a gear member; and

a rotary gear member arranged between the swing lever and the electric driving source in mesh with the gear member of the electric driving source, the rotary gear member being directly and engageably connected to the swing lever.

BRIEF DESCRIPTION OF THE DRAWINGS

Fig. 1 is an exploded perspective view of a door lock device of an embodiment of this invention;

Fig. 2 shows an enlarged perspective view of one part of Fig. 1;

Fig. 3 shows an enlarged perspective view of another part of Fig. 1;

Fig. 4 shows a vertical cross-sectional view of a part of the door lock system;

Fig. 5 shows a vertical cross-sectional view of Fig. 4 taken along the lines V-V;

Fig. 6 shows a horizontal cross-sectional view of Fig. 4 taken along the lines VI-VI;

Fig. 7 shows a side view of structural members of the door lock system being in an unlocked state;

Fig. 8 shows a side view of an inside of the door lock system being in a locked state;

Fig. 9 shows a side view of the inside of the door lock system which is in the unlocked state when an outside handle is operated;

Fig. 10 shows a side view of the inside of the door lock system which is in the locked state when an outside handle is operated;

Fig. 11 shows a side view of the inside of the door lock system in a cancelling operation;

Fig. 12 shows a side view of the inside of the door lock system in a keyless locking operation; and

Fig. 13 shows a side view of the inside of the door lock system in a one-motion operation.

DESCRIPTION OF THE PREFERRED EMBODIMENT

Fig. 1 shows a set of three orthogonally arranged double-headed arrows indicating the longitudinal, vertical and width directions of the vehicle. The illustrated embodiment of the invention is a door lock system which is described below as being aligned with the vehicle as it would be if it were mounted in a vehicle door and the door closed.

The door lock system is disposed within a door of the vehicle, and is formed to accommodate a first link mechanism 20 and a second link mechanism 30 in a housing 10. The housing 10 comprises a main body 11, a first cover 12 and a second cover 13. The main body 11 includes a first casing portion 11a which has a dish shape being open to the vehicle inside direction and a second casing portion 11b which has a dish shape being perpendicular to the first casing portion 11a and is open to the vehicle back side direction. The first casing portion 11a and the second casing portion 11b are integrally formed therewith. The first cover 12 is attached to the first casing portion 11a at the opening side thereof, and the second cover 13 is attached to the second casing portion 11b at the opening side thereof, whereby the opening of the first casing

portion 11a is closed by the first cover 12, and the opening of the first casing 11b is closed by the second cover 13.

In the housing 10, both an electric distribution plate 14 electrically connected to an electric motor 25 as an actuator and structural members of the first link mechanism 20 are disposed so as to be accommodated between the first casing portion 11a and the first cover 12. A sub base plate 15 and structural members of the second link mechanism 30 are disposed so as to be accommodated between the second casing portion 11b and the second cover 13. A latch base plate 16 is attached to the second cover 13 at an opening side thereof, whereby the opening of the second cover 13 is closed and covered by the latch base plate 16. Each structural member of a latch mechanism 40 is disposed so as to be accommodated between the inside of the second cover 13 and the latch base plate 16.

As shown in Fig. 2, a slave inside opening lever 21 is rotatably supported within the first cover 12 by a supporting pin 21a so as to be rotatably movable in a vertical plane aligned with the longitudinal direction of the vehicle. A master inside opening lever 51 is rotatably supported on the outer face of the first cover 12 by the supporting pin 21a so as to be rotatably movable in a vertical plate aligned with the longitudinal direction of the vehicle. The slave inside opening lever 21 has an engaging projection 21b which extends in the vehicle inside direction through a sector-shaped hole 12a formed in the first cover 12. The engaging projection 21b of the slave inside opening lever 21 engages with a connecting hole 51a in the master inside opening lever 51, whereby the engaging projection 21b connects the slave inside opening lever 21 to the master inside opening lever 51 for movement as one. The slave inside opening lever 21 has an engaging projection 21c which extends in the vehicle outside direction. When the slave inside opening lever 21 is rotated in the clockwise sense as shown in Fig. 8, the engaging projection 21c engages with a cancelling lever 22, and the cancelling lever 22 is rotated.

The master inside opening lever 51 is connected with an inside cable 52 which is connected with an inside handle (not shown) disposed inside of the vehicle. The

rotation of the inside handle in the door opening direction causes the master inside opening lever 51 to rotate in the clockwise sense as indicated in Fig. 1, Fig. 2 and Fig. 7 thereby rotating the slave inside opening lever 21 in the same direction.

The cancelling lever 22 is rotatably supported within the first cover 12 by a supporting pin 22a formed integrally with the first cover 12. The cancelling lever 22 is provided immediately adjacent and parallel to the slave inside opening lever 21 and lies alongside the slave inside opening lever 21 in the vehicle outside direction. The cancelling lever 22 has an engaging pin 22b which extends in the vehicle outside direction. The engaging pin 22b is inserted into a first engaging groove 23a formed in an floating link 23 disposed adjacent and parallel to the cancelling lever 22, alongside the cancelling lever 22 in the vehicle outside direction.

The first engaging groove 23a of the cancelling lever 22 is a V-shaped groove. The floating link 23 also has an elongated second engaging groove 23b into which an engaging pin 27b of an swing lever 27 is slidably received. An engaging portion 23c of the floating link 23 is formed as a L-shaped plate with which an end of the slave inside opening lever 21 engages. A connecting portion 23d of the floating link 23 connects the floating link 23 to an outside opening lever 31. The floating link 23 is supported by the cancelling lever 22, the swing lever 27 and the outside opening lever 31.

A locking lever 24 is rotatably supported on the first casing portion 11a at the inside thereof by a supporting pin 24c (Fig. 4) formed integrally with the main body 11 so as to be rotatably movable in a vertical plane aligned with the longitudinal direction of the vehicle. The locking lever 24 lies parallel to and alongside the floating link 23. The locking lever 24 has an attachment hole 24a into which a locking cable 53 is fixed and an elongated engaging groove 24b into which the engaging pin 27b of the swing lever 27 is inserted. The locking cable 53 is connected with a locking knob (not shown) disposed on a door at the inside of the vehicle. When the locking knob is operated for locking the door, the locking cable 53 transmits an operation force from

the locking knob to the locking lever 24, thereby rotating the locking lever 24 in the clockwise direction as shown in Fig. 1.

The electric motor 25 generates the operation force for moving the first link mechanism 20. The electric motor 25 is attached to the first cover 12 between the first cover 12 and the first casing portion 11a. The electric motor 25 includes a worm gear 25a on an output shaft of the electric motor 25. The worm gear 25 is in mesh with a wheel gear 26. The wheel gear 26 has a pair of engaging pins 26a, 26b on the outside thereof. The wheel gear 26 is rotatably supported by the first cover 12 by a supporting boss 26c formed integrally with the first cover 12. The engaging pins 26a and 26b are arranged one on each side of the rotational centre of the wheel 26 and are spaced apart in the longitudinal direction of the vehicle such that a predetermined space is defined between engaging pins 26a and 26b. Either engaging pin 26a or 26b extends into an engaging concave portion 27c of the swing lever 27.

The swing lever 27 is disposed between the wheel gear 26 and the floating link 23. The swing lever 27 is rotatably supported on the first cover 12 at the inside thereof by a supporting boss 27f formed integrally with the first cover 12. The swing lever 27 includes a main lever portion 27a, a projecting portion 27d having a spring function and a cushion rubber 27e. The main lever portion 27a carried the engaging pin 27b projecting in the vehicle outside direction and an engaging concave portion 27c opening in the vehicle inside direction. The projecting portion 27d is provided at an upper end of the main lever portion 27a. The cushion rubber 27e is disposed on the portion between the main lever portion 27a and the projecting portion 27d. The engaging pin 27b of the swing lever 27 extends through the second engaging groove 23b of the floating link 23 and the engaging groove 24b of the locking lever 24. The engaging concave portion 27c of the swing lever 27 receives either of the engaging pins 26a or 26b. An end of the projecting portion 27d of the swing lever 27 elastically contacts an inner periphery of the first cover 12.The engaging concave portion 27c of the swing lever 27 is formed so that either the front engaging pin 26a or the rear engaging pin 26b can be engaged with the swing lever 27 when the wheel gear 26 is rotated in either the forward or the reverse directions, the swing lever 27 can be

rotated in either the clockwise direction or the counter-clockwise direction as shown in Figs. 7 and 8. The end of the projecting portion 27d slidably moves on the inner periphery of the first cover 12 and selectively engages with either of two engaging concave portions 12b or 12c (Fig. 7). The cushion rubber 27e selectively contacts either of two stopper portions 11c or 11d in accordance with the above motion of the projecting portion 27d.

A key lever 28 has a cylinder-shaped main body 28a and a lever portion 28b formed integrally with the cylinder-shaped main body 28a. The key lever 28 and idle lever 29 are rotatably supported by a supporting boss 28e formed integrally with the first casing portion 11a and a supporting boss 28f formed integrally with the first cover 12. The key lever 28 has an engaging groove 28c provided in the main body 28a and an engaging pin 28d provided on the lever portion 28b at the opposite side thereof (Fig. 2). An end of a projecting pin of a key cylinder (not shown) which is disposed on the outside of the door is disposed into the engaging groove 28c. The engaging pin 28d extends into a sector-shaped engaging groove 29a formed in the idle lever 29. The key lever 28 is rotated by the rotation of the key cylinder turned by a key (not shown). The key lever 28 rotates the idle lever 29 via the engaging pin 28d, and the idle lever 29 selectively rotates the swing lever 27 in the clockwise direction or the counter-clockwise directions (as indicated in Figs 7 and 8) via a connecting pin 29b formed integrally with the idle lever 29.

Each structure member of the second link mechanism 30 (Fig. 3) is disposed so as to be accommodated between the second casing portion 11b of the main body 11 and the second cover 13. The outside opening lever 31 of the second link mechanism 30 is rotatably supported between the second casing portion 11b and the sub base plate 15 by a supporting pin 31a via a torsion spring 31b. The outside opening lever 31 is rotatably movable in the vertical plane aligned with the width direction of the vehicle between the second casing portion 11b and the sub base plate 15. A rotating end 31c of the outside opening lever 31 is connected with an outside link connected to an outside handle (not shown) disposed on the outside of the door. The outside opening lever 31 is rotated in the counter-clockwise direction as indicated in Fig. 4 against the

force of the torsion spring 31b by the operation of the outside handle in a door opening direction (the operation of opening the door using the outside handle). A lifting lever 32 is disposed on a periphery of a pawl shaft 42b for unitary rotation with the pawl shaft 42b. The pawl shaft 42b is rotatably supported by a bush 33 as it extends through the second cover 13. An engaging portion 32a formed on periphery of the lifting lever 32 is extended above the upper end of the engaging portion 23c of the floating link 23.

The latch mechanism 40 includes a latch 41, the pawl 42 and a pair of torsion springs 43 and 44 applying spring forces to the latch 41 and the pawl 42, respectively. The latch 41 is rotatably supported between the second cover 13 and the latch base plate 16 by a supporting pin 41a. The supporting pin 41a extends through the sub base plate 15, the second cover 13 and the latch base plate 16 and is supported by both the second cover 13 and the latch base plate 16. One end of the torsion spring 43, which encircles the supporting pin 41a, is engaged with the latch 41. The other end of the torsion spring 43 is engaged with the second cover 13. The torsion spring 43 applies the predetermined spring force to the latch 41 for regulating the rotation of the latch 41 so that after rotation of the latch 41 it can be returned to its initial position by the spring force. The latch 41 is held by the torsion spring 41 so that an opening of a latch groove 41b is substantially aligned with an opening of a insertion grove 16a formed in the latch base plate 16. The pawl 42 includes a block-like main pawl body 42a and the pawl shaft 42b extending approximately perpendicular to the main pawl body 42a. The pawl shaft 42b extends into the second casing portion 11b through the second cover 13 and the sub base plate 15 via the bush 33. The shaft 42b is rotatably supported by the sub base plate 15 via the bush 33. The pawl shaft 42b is further rotatably supported by the base plate 16 via the bush 34. The torsion spring 44 is provided around the pawl shaft 42b between the main pawl body 42a and sub base plate 15. The lifting lever 32 is rigidly connected to one end of the pawl shaft 42b for unitary rotation therewith. (After the torsion spring 44 is provided on the pawl shaft 42b, the end of pawl shaft 42b is disposed into the lifting lever 32 and formed with a head by riveting as shown in Fig. 5). Open end of the torsion spring 44 is engaged with the pawl 42. The other end of the torsion spring 44 is engaged with the sub base

plate 15. The torsion spring 44 applies a predetermined spring force to the pawl shaft 42b for regulating the rotation of the pawl shaft 42b so that the pawl 42 can be returned to its initial position by the spring force when the pawl 42 is rotated. The pawl 42 causes the main pawl body 42a to contact the periphery of the latch 41.

When a striker 45 which is mounted on a body of the vehicle relatively moves into the latch 41 through the insertion groove 16a, the latch 41 is rotated against the spring force of the torsion spring 43 by the pressure of the striker 45. As the latch 41 is rotated by the striker 45, the pawl 42 slidably contacts the outer periphery of the latch 41, and moves into engagement with a latch portion 41c. The pawl 42 holds the latch 41 which has been rotated by the striker 45, and thus the pawl 42 keeps the latch 41 in its rotated condition and retains the striker 45. Under the above state, the door of the vehicle is closed. Under the above engagement state, the latch 41 is biased towards its initial position by the force of the torsion spring 43. When the pawl 42 is rotated to be moved away from the latch portion 41c by the rotation of the lifting lever 32, the latch 41 is returned by the spring force of the torsion spring 43, until the opening of the latch groove 41b matches the opening of the insertion groove 16a. Under the above state, the striker 45 can be moved out of the latch groove 41b, and the door of the vehicle can be opened.

There are eight operation modes of the above door lock system to be considered. These include operation modes causing the door lock system to be in the unlocked state capable of releasing the engagement between the latch 41 and the striker 45; operation modes causing the door lock system to be in the locked state incapable of releasing the engagement between the latch 41 and the striker 45; and operation modes effective to cause the door to open or close when the door lock system is in the unlocked state. The eight operation modes will be described as follows.

First operation mode: To cause the door to open by operating the inside handle disposed on the inside of the vehicle when the door lock system is in the unlocked state as viewed in Fig. 7.

In the door lock system, when the inside handle is operated to open the door, the master inside opening lever 51 is rotated in a clockwise direction (as indicated in Fig. 1) via the inside cable 52. The slave inside opening lever 21 is thus rotated by the master inside opening lever 51 in the clockwise direction (as indicated in Fig. 7). When the slave inside opening lever 21 is rotated in the clockwise direction (as indicated in Fig. 7), the end of the slave inside opening lever 21 engages with the lower surface of the engaging portion 23c of the floating link 23 and pushes up the floating link 23. The floating link 23 causes the upper periphery of the engaging portion 23c to engage with the engaging portion 32a of the lifting lever 32, so that the lifting lever 32 is rotated by the floating link 23. The pawl 42 is rotated by the lifting lever 32 to be moved away from the latch portion 41c of the latch 41. Thus the restriction against rotation of the latch 41 by the engagement with the main pawl body 42a is released. Thus, the latch 41 is returned to its initial position by the spring force of the torsion spring 43, and the striker 45 is released. Thus the engagement between the latch 41 and the striker 45 is released by operating the inside handle for door opening, and the door can be opened.

Second operation mode: To cause the door to open by operating the outside handle disposed on the outside of the vehicle when the door lock system is in the unlocked state as viewed in Fig. 7.

In the door lock system, when the outside handle is operated to open the door, the outside opening lever 31 is rotated against the torsion spring 31b, and the floating link 23 is pushed up by the outside opening lever 31. The floating link 23 causes the upper periphery of the engaging portion 23c to engage with the engaging portion 32a, so that the lifting lever 32 is rotated by the floating link 23. The lifting lever 32 rotates the pawl 42 to be separated from the latch portion 41c of the latch 41. Thus the restriction against rotation of the latch 41 by the engagement with the main pawl body 42a is released. Thus, the latch 41 is returned to its initial position by the spring force of the torsion spring 43, and the striker 45 is released. Thus the engagement between the latch 41 and the striker 45 is released by operating the outside handle for door opening, and the door can be opened.

In the first and second operation mode, when the floating link 23 is pushed up by the outside opening lever 31 or the slave inside opening lever 21, the cancelling lever 22 is rotated in the counter clockwise direction shown in Fig. 7 by the engagement between the first engaging groove 23a of the floating link 23 and the engaging pin 22b of the cancelling lever 22.

Third operation mode: To operate the locking knob inside the vehicle so as to bring the door lock system into its locked state wherein the release of the engagement between latch 41 and the striker 45 is made impossible.

When the door lock system is in the unlocked state as viewed in Fig. 7, the locking cable 53 is moved by operating the inside locking knob, which rotates the locking lever 24 clockwise as viewed in Fig. 2. This causes rotation of the swing lever 27 in the counterclockwise direction as shown in Fig.7. Thus the swing lever 27 causes the floating link 23 to rotate clockwise about the connecting portion between the floating link 23 and the outside opening lever 31 by the engagement between the second engaging groove 23b and the engaging pin 27b, thereby shifting the floating link 23 from the unlocking position shown in Fig. 7 to the locking position shown in Fig. 8. The unlocking position is the position in which the floating link 23 causes the door lock system to be in the unlocked state, the locking position is the position in which the floating link 23 causes the door lock system to be in the locked state. Even if the floating link 23 is moved as viewed in Fig. 10 by operating the outside handle, the floating link 23 fails to engage with the lifting lever 32, whereby the lifting lever 32 and the pawl 42 are not rotated. Thus even if the inside handle or the outside handle are operated for opening the door, they are ineffective to release the latch 41, and the door cannot be opened. When the floating link 23 is moved from the unlocking position shown in Fig. 7 to the locking position shown in Fig. 8, the cancelling lever 22 is rotated in the counter clockwise direction shown in Fig. 8 by the engagement between the first engaging groove 23a of the floating link 23 and the engaging pin 22b.

Fourth operation mode: To bring the door lock system into either the locked state or the unlocked state by key operated rotation of the key cylinder from outside of the vehicle.

In the door lock system, when the key cylinder is rotated by the key, the key lever 28 is rotated and the swing lever 27 is selectively rotated by the key lever 28 via the idle lever 29 to be in either the position shown in Fig. 7 or the position shown in Fig.8. The floating link 23 is selectively moved by the swing lever 27 to be in the unlocking position shown in Fig.7 or the locking position shown in Fig.8 via the engagement between the second engaging groove 23b and the engaging pin 27b. The rotation of the key cylinder by manipulating the key causes the door lock system selectively to be in either the unlocked state of Fig. 7 capable of releasing the engagement between the latch 41 and the striker 45 or the locked state of Fig. 8 incapable of releasing the engagement.

Fifth operation mode: To bring the door lock system into either the locked state or the unlocked state by remote control of the electric motor 25.

In the door lock system, when the motor remote control is operated, the electric motor 25 rotates the wheel gear 26 through a predetermined angle via the worm gear 25a. When the wheel gear 26 rotates in one or the other direction, either the engaging pins 26a or 26b selectively engages a part of engaging concave portion 27c of the swing lever 27, to rotate the swing lever 27 to the position shown in Fig. 7 or the position shown in Fig. 8. Therefore, the floating link 23 is selectively moved to be in the unlocking position shown in Fig. 7 or the locking position shown in Fig. 8 via the engagement between the second engaging groove 23b and the engaging pin 27b. Thus the operation of the lock/unlock switch of the key causes the door lock system selectively to be in either the unlocked state capable of releasing the engagement between the latch 41 and the striker 45 by the opening operation of the outside handle or the locked state incapable of releasing the engagement.

Sixth operation mode (cancelling operation): If the door is open, with the door lock system in its locked state (caused by a manual operation of the locking knob) and the door is then closed without operating the door handle, the locking condition is cancelled.

In the door lock system, when the mechanism is in the locked condition of Fig. 8 and the door is closed, the striker 45 causes the latch 41 to rotate. Accordingly, the pawl 42 rotates by the rotation of the latch 41. Then the lifting lever 32 rotates to the position shown in solid lines in Fig. 11, thereby rotating the cancelling lever 22 from the position shown in chain-double-dotted lines in Fig. 11 to the position shown in solid lines in Fig. 11. This causes the floating link 23 to move from the locking position shown in chain-double-dotted lines in Fig. 11 to the unlocking position shown in solid lines by the engagement between the first engaging groove 23a and the engaging pin 22b. Thus the door lock system is reset into its unlocked state, and the door can be opened by either the outside handle or the inside handle as described above.

Seventh operation mode (keyless locking operation): If the door is open, with the door lock system in its locked state (caused by a manual operation of the locking knob) and the door is then closed while operating the outside door handle, then the above cancelling operation is avoided and the door is locked.

In the door lock system, when the outside handle is operated while the door lock system is in the locked state, the outside opening lever 31 is rotated to push the floating link 23 up as shown in Fig. 12. Thus the engaging pin 22b of the cancelling lever 22 is located at a lower end of the first engaging groove 23a to be out of engagement with anything. When the door is closed with the mechanism in the above condition, the latch 41 is rotated by the striker 45 and the pawl 42 causing the lifting lever 32 to rotate, whereby the cancelling lever 22 is rotated in the clockwise direction in Fig. 12. But the engaging pin 22b of the cancelling lever 22 is located in the first engaging groove 23a of the floating link 23 to be out of engagement with anything, so the floating link 23 is kept in the locking position and is not moved to the unlocking

position. Thus the door lock system can be in the locked state which is incapable of releasing the engagement between the latch 41 and the striker 45 when the door is closed. Moreover when the outside handle is subsequently released, the condition as shown in Fig. 12 is changed to the condition as shown in Fig. 8, whereby the door lock system maintains the locked state.

Eighth operation mode (one motion operation): When the door is locked, it can still be opened by the inside handle. Use of the inside handle simultaneously cancels the locking condition.

In the door lock system, when the mechanism is in the locked condition of Fig. 8 and the inside handle is operated for the door opening, the master inside opening lever 51 and the slave inside opening lever 21 are rotated as one unit, and the engaging projection 21c of the slave inside opening lever 21 rotates the cancelling lever 22 clockwise, which causes the floating link 23 to move from the locking position shown in chain-double-dotted lines in Fig. 13 to the unlocking position shown in solid lines in Fig. 11 by the engagement between the first engaging groove 23a and the engaging pin 22b. Thus the swing lever 27 and the idling lever 29 are moved from the locking position shown in chain-double-dotted lines in Fig. 13 to the unlocking position indicated in solid lines in Fig. 11 by the engagement between the second engaging groove 23b and the engaging pin 27b. In this way the floating link 23 is pushed up by the slave inside opening lever 21, thereby causing the lifting lever 32 and the pawl 42 to rotate, so that the door can be opened.

All members of the first link mechanism 20 and the second link mechanism 30 of the door lock system are accommodated within the housing 10. No members of these link mechanisms 20, 30 are placed outside the housing 10. Thus no member of either the first link mechanism 20 and the second link mechanism 30 can be operated from outside of the door through the gap between the door and the body of the vehicle, which provides excellent security. In addition, since no member of either the first link mechanism 20 and the second link mechanism 30 is exposed outside the housing 10, all those members are protected from exposure to water entering the door.

In order that each structural member of the first link mechanism 20 is accommodated between the first casing portion 11a of the main body 11 and the first cover 12, each structural member is provided as follows. The wheel gear 26 (as a rotary gear member) is connected to the floating link 23 via the swing lever 27 (as a swing lever), Furthermore, the wheel gear 26, the swing lever 27 and the floating link 23 overlie one another between the first casing portion 11a of the main body 11 and the first cover 12. Thus, such an arrangement is much more compact than an arrangement wherein functional members such as the wheel gear 26, the floating link 23 and the swing lever 27 are arranged in series or are mutually offset. In addition, such an arrangement causes the space in which the functional members are accommodated to be much smaller, thereby miniaturizing the housing 10, whereby the door lock system as a whole can be downsized.

In the above configuration for the door lock system, the flexible projecting portion 27d is formed integrally with the swing lever 27. When the floating link 23 is selectively moved by the rotation of the swing lever 27 to either the unlocking position or the locking position, the projecting portion 27d of the swing lever 27 elastically engages with one or other of engaging concave portions 12b or 12c. Thus the above engagement between the projecting portion 27d and the concave portion 12b or 12c gives a reaction "feel" to the movement of the floating link 23 to either the unlocking position or the locking position. In this case, a separate mechanism for creating that reaction "feel", such as an over-centre spring, can be abolished.

In addition, in the door lock system, the slave inside opening lever 21 transmits the operation force for door opening using the inside handle. The floating link 23 selectively locks or unlocks the engagement between the latch 41 and the striker 45. The floating link 23 releases the engagement between the latch 41 and the striker 45 when the door lock system is in the unlocked state. The slave inside opening lever 21 and the floating link 23 are provided in parallel planes each being a vertical plane aligned with the longitudinal direction of the vehicle, so that the floating link 23 can be moved in its plane by directly engaging with the slave inside opening lever 21. The

engagement between the slave inside opening lever 21 and the floating link 23 can be established even when the location of the inside door handle is changed in the vertical or longitudinal directions of the vehicle within the door. Thus the location of the inside handle may be sufficiently flexible in vertical or longitudinal directions of the vehicle in the door, and the inside handle can be set in an optimal position for drivers and occupants operating the inside handle.

CLAIMS:

1. A door lock system for a vehicle, comprising a latch mechanism securable to a vehicle door for latching the vehicle door to a vehicle body, and a latch release mechanism comprising:

a floating link movable between an unlocked condition in which it is engageable with the latch mechanism for release thereof and a locking condition in which it cannot engage the latch mechanism;

a swing lever connected to the floating link;

an electric driving source having a gear member; and

a rotary gear member arranged between the swing lever and the electric driving source in mesh with the gear member of the electric driving source, the rotary gear member being directly and engageably connected to the swing lever.

2. A door lock system for a vehicle according to claim 1, wherein the floating link is arranged in the same plane as the swing lever.

3. A door lock system according to claim 2, wherein the swing lever carries a pivot pin receivable in a slot in the floating link to transmit movement therebetween.

4. A door lock system according to any preceding claim, further comprising an inside opening lever arranged in a plane parallel to the floating link and being engageable with the floating link.

5. A door lock system according to any preceding claim, further comprising an outside opening lever arranged in a plane perpendicular to the floating link and rotatably supporting the floating link.

6. A door lock system according to any preceding claim, further comprising a housing enclosing all components of the latch release mechanism.

7. A door lock system according to claim 6, wherein the swing lever and the rotary gear member are rotatably supported by the housing.

8. A door lock system according to any preceding claim, wherein the connection between the rotary gear and the swing member comprises a concave portion of the swing member engageable by an eccentric pin carried by the rotary gear member so that on rotation of the rotary gear member the pin engages a wall portion or portions of the concave portion and effects swing movement of the swing member to move the floating link between its unlocked and locked conditions.

9. A door lock system according to claim 8, wherein there are two eccentric pins on the rotary gear member, either one of which can engage the wall portion or portions of the concave portion of the swing member to effect the swing movement thereof.

10. A door lock system substantially as described herein with reference to the drawings.

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Application No: GB 0106687.7 **Examiner:** Barnaby Wright
Claims searched: 1-10 **Date of search:** 2 July 2001

Patents Act 1977
Search Report under Section 17

Databases searched:

UK Patent Office collections, including GB, EP, WO & US patent specifications, in:

UK Cl (Ed.S): E2A (AARN, AMXF)

Int Cl (Ed.7): E05B (65/12, 65/20)

Other: Online: EPODOC, JAPIO, WPI

Documents considered to be relevant:

Category	Identity of document and relevant passage		Relevant to claims
X	GB 2350644 A	(MITSUI) See especially figs 1-7, and page 4, ln 13 to page 6, ln 16.	1 at least
X	GB 2349171 A	(MITSUI) See especially figs 1-7, and page 5, ln 20 to page 7, ln 23.	1 at least
X	GB 2335946 A	(KIEKERT) See especially figs 1-6, and page 8, ln19 to page 9, ln 17, and page 10, ln 8 to page 11, ln 9.	1 at least
X	GB 2257467 A	(OHI) See especially figs 1-6, and Abstract.	1 at least
X	GB 2221719 A	(KIEKERT) See whole document.	1 at least

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